Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Authorization and Use of	)	ET Docket No. 00-47
Software Defined Radios	)	
	)	

To: The Commission

COMMENTS

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March 19, 2001

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COMMENTS OF CINGULAR WIRELESS LLC

Cingular Wireless LLC ("Cingular") hereby submits comments in response to the *Notice of Proposed Rulemaking* in the above-referenced proceeding.[1] Cingular supports the FCC's efforts to investigate software defined radio technology ("SDR") and its pragmatic approach with respect to the need for SDR rules.

INTRODUCTION AND SUMMARY

Cingular provides wireless voice and data Commercial Mobile Radio Services ("CMRS") to more than 20 million customers in 38 states, the District of Columbia and two U.S. territories. Cingular agrees that there are potential benefits that SDR technology can bring to equipment manufacturers, service providers, and users of wireless technology. Although SDR technology likely will have limited benefits for CMRS carriers in the near term, these benefits may include:

- permitting manufacturers to more easily reconfigure equipment to fix bugs and implement upgrades;

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[1] *Authorization and Use of Software Defined Radios*, ET Docket No. 00-47, FCC 00-430 (rel. Dec. 8, 2000) ("*NPRM*").

- allowing the use of common manufacturing platforms and reducing the number of equipment components which, in turn, may lower equipment manufacturing costs; and
- making the implementation of spectrally efficient technologies, such as fully adaptive smart antennas, economically viable.

In order to spur these developments, Cingular has been an active member of the Software Defined Radio Forum.[2] Moreover, Cingular's predecessors-in-interest have been active participants in this docket since the outset and, given the nascency of SDR, have previously urged the Commission to refrain from adopting extensive rules governing implementation of SDR.[3] Cingular supports the restraint shown by the Commission in the *NPRM*. As the Commission correctly notes, only general rules governing the equipment authorization process are warranted at this time.

As discussed below, the Commission should investigate and promote SDR technology as a potential mechanism for improving spectral efficiency. These efforts, however, do not lessen the need for additional spectrum allocations. Cingular also supports the proposed modifications to the equipment authorization process. The modifications are necessary to remove potential regulatory impediments to the development of SDR. Because SDR is still at the early stage of development, Cingular opposes any other rule changes at this time.

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[2] The Software Defined Radio Forum is an organization dedicated to supporting the development, deployment, and use of open architectures for advanced wireless systems. In particular, the Forum is attempting to (i) accelerate the proliferation of enabling software definable technologies necessary for the introduction of advanced devices and services for the wireless Internet, and (ii) develop uniform requirements and standards for SDR technologies to extend capabilities of current and evolving wireless networks.

[3] *See* SBC Wireless Comments, ET Docket No. 00-47 (June 14, 2000) ("SBC Comments"); BellSouth Corporation Comments, ET Docket No. 00-47 (June 14, 2000) ("BellSouth Comments").

I. SDR DOES NOT OBVIATE THE NEED FOR ADDITIONAL SPECTRUM ALLOCATIONS

Spectrum management is one of the Commission's core functions and this function is increasingly important given the demand for spectrum generated by new services.[4] The Commission has defined its spectrum management function as comprising two key elements: (i) allocating additional spectrum to meet demand; and (ii) promoting greater efficiencies in spectrum use.[5] Cingular supports the Commission's recent efforts in this docket and the *Secondary Markets* docket to promote greater spectrum efficiency.[6] These efforts, however, satisfy only one prong of the Commission's spectrum management function and do not obviate the need for additional spectrum allocations. This is especially true with respect to the current docket. Based on its work with the SDR Forum, Cingular doubts whether SDR will have any impact on spectrum needs for at least a decade.[7]

Moreover, the Commission should not emphasize the creation of spectrum efficiency at the expense of additional spectrum allocations. These two prongs of the Commission's spectrum management policy have a symbiotic relationship and warrant equal attention.

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[4] *Principles for Reallocation of Spectrum to Encourage the Development of Telecommunications Technologies for the New Millennium*, 14 F.C.C.R. 19868, ¶ 6 (1999) ("*Policy Statement*").

[5] *Policy Statement*, 14 F.C.C.R. at ¶¶ 6-14.

[6] *See Promoting Efficient Use of Spectrum Through the Elimination of Barriers to the Development of Secondary Markets*, WT Docket No. 00-230, FCC 00-402 (rel. Nov. 27, 2000).

[7] *Accord* BellSouth Comments at 4-6; Ericsson Comments, ET Docket No. 00-47, at 3 (June 14, 2000); Motorola Comments, ET Docket No. 00-47, at v, 27-28 (June 14, 2000); Nokia Comments, ET Docket No. 00-47, at 7 (June 14, 2000); Nortel Comments, ET Docket No. 00-47 at ii, 4, 12 (June 14, 2000) ("Nortel Comments"); SBC Comments at 14; BellSouth Reply Comments, ET Docket No. 00-47, at 3-5.

II. THE RULES GOVERNING THE EQUIPMENT AUTHORIZATION PROCESS SHOULD BE MODIFIED

Cingular generally opposes the adoption of specific rules for SDR, but it supports the elimination or modification of rules that could serve as a regulatory impediment to SDR development. In this regard, Part 2 of the FCC's rules should be modified to classify changes in the frequency, power, and modulation type of a SDR as "permissive" changes.[8] These proposed modifications will encourage equipment manufacturers to adopt SDR technology, thereby expediting its introduction to the CMRS industry.

It is premature to define SDR; it would be better done after the completion of baseline work by the SDR Forum and the ITU-R Study Group 8. If it must be done at this time, it should be solely for the limited purpose of the FCC's equipment authorization rules. The FCC has proposed the following definition:

> A software defined radio is a radio that includes a transmitter in which the operating parameter of the transmitter, including the frequency range, modulation type or maximum radiated or conducted output power can be altered by making a change in software without making any hardware changes.[9]

This definition should be modified to expressly *exclude* radios that use software simply to switch between different modes of operation that have different hardware-defined power or frequency parameters.[10] This modification is necessary to ensure that the definition does not encompass cellular telephones that only use software to control functions such as power or frequency. In addition, Cingular suggests that the Commission clarify that the term "transmitter" includes transceivers, because SDR devices will often have

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8 *NPRM* at ¶¶ 22-31.

9 *NPRM* at ¶ 21.

10 This appears to be the intent of the footnote following the definition in the *NPRM*. *NPRM* at ¶ 21, n.37.

both send and receive capabilities. Indeed, the software changes that control the characteristics of a transmitter may be input via a radio receiver.

A. The Commission Should Adopt a New Class of Permissive Changes

As the Commission properly recognized, its current equipment authorization rules could inhibit SDR development by requiring FCC approval and specific labeling before equipment could be operated on parameters different from those originally authorized.[11] Accordingly, Cingular supports the creation of a new class of permissive changes — Class III — with respect to changes in the frequency, power, and modulation type of a SDR.

Cingular agrees with the Commission, however, that the following criteria must be met before an equipment modification can qualify as a Class III permissive change:

- there must be no modification to equipment hardware;[12]
- each combination of hardware and software that the radio supports should be tested for approval;[13] and
- the equipment authorization must identify the equipment as a SDR.[14]

These minimal criteria will help ensure that modifications to SDR equipment do not cause unanticipated interference.

B. FCC Approval of SDR Devices Should Be Required

As discussed above, Class III permissive changes should be conditioned upon FCC approval of SDR devices. The Commission should implement its tentative conclusion that radio hardware and software

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[11] *NPRM* at ¶¶ 22-29.

[12] *NPRM* at ¶ 26. Cingular opposes classifying changes to both hardware and software as permissive changes. *See NPRM* at ¶28.

[13] *NPRM* at ¶¶ 18, 24.

[14] *NPRM* at ¶ 26.

should be approved together.[15] As the record developed in response to the *NOI* in this docket establishes, "software defined radio technology has not matured to the point where it is possible to predict radio RF parameters from examining only the hardware or software."[16]

Because SDR devices will likely support multiple modes of operation, with each mode having potentially different RF emission characteristics, the equipment approval process also should be contingent upon the full testing of all modes of operation possible on an SDR device. Such a procedure is necessary to ensure that software changes affecting the RF emission characteristics of one mode of a device would not inadvertently affect the RF emission characteristics of another mode of that device. The Commission should assess heavy forfeitures when interference is caused by an SDR device that is not operating in accordance with its authorized parameters.

In addition to evaluating the operational parameters of SDR equipment, the Commission also should test the equipment to ensure that unauthorized software modifications can not be made.[17] Although Cingular agrees with the Commission that it is "premature . . . to propose specific requirements for authentication while standards are still under development,"[18] the equipment authorization rules should expressly state that FCC approval can only be obtained upon a showing that unauthorized software modifications can not be made. "Unauthorized software modifications" should be defined as the installation

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[15] *NPRM* at ¶ 18.

[16] *See NPRM* at ¶16 (citing NTIA Comments, ET Docket No. 00-47 at 20 (June 14, 2000)). *See also* SBC Comments at 17; SDR Forum Comments, ET Docket No. 00-47 at 31 (June 14, 2000).

[17] *NPRM* at ¶ 31.

[18] *NPRM* at ¶ 31. Cingular believes that the development of authentication standards should be industry sponsored — rather than developed by the FCC — and applicable to all types of SDR. Moreover, authentication systems must allow for the development of application software by third-party developers.

of any software on an SDR that produces a combination of hardware and software not previously approved by the Commission. The equipment authorization should be conditioned upon the continued integrity of the authentication or security system. Adoption of this language will place manufacturers on clear notice that adequate security mechanisms must be integrated into SDR equipment.

Hence, the Commission should adopt its proposal that the manufacturer must take steps to ensure that only software that is part of a hardware/software combination approved by the Commission can be loaded into a radio. The grantee of the equipment authorization is responsible for ensuring the integrity of the authentication or security system.

It is premature to adopt a manufacturer self-approval approach to equipment authorization.[19] As the FCC properly notes:

> Equipment is generally placed in the self-approval category after the Commission has gained some experience that manufacturers can and will produce equipment that complies with the rules. Further experience with software defined radio equipment is necessary before we can determine whether self-approval is appropriate.[20]

Once the Commission gains experience with SDR, the self-approval process can be revisited.

Lastly, once SDR equipment has been approved by the Commission, the manufacturer should be required to affix an electronic label to the equipment.[21] This label should display the FCC identification number.[22] These labels could be designed to change automatically based upon the hardware and software

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[19] *NPRM* at ¶ 24.

[20] *NPRM* at ¶ 24.

[21] *NPRM* at ¶ 29.

[22] In this regard, the FCC may want to assign a different identification number for each software and hardware combination. This would allow field personnel to readily identify the particular hardware/software combination deployed on the SDR device.

installed in the SDR. The electronic label should be protected by an authentication system so as to prevent any unauthorized parties from making changes to the electronic label. The electronic label also could be designed to indicate if the SDR were operating in an unauthorized manner.[23]

C. The Marketing of Software Capable of Causing SDR Devices to Operate in Violation of FCC Rules Should be Prohibited

The Commission should establish rules prohibiting manufacturers, grantees, or third parties from knowingly marketing software that would cause a software defined radio to operate in violation of the Commission's rules. Software for SDR devices should be marketable only after the software has received an equipment authorization for use in conjunction with specified SDR hardware. Such rules are necessary to ensure that SDR devices do not cause out of band interference. Such out of band radiation can cause interference in a network operator's system and have a direct impact on the capacity and the quality of service that can be supported by the system.

III. NO OTHER RULE CHANGES ARE WARRANTED AT THIS TIME

With the exception of liberalizing the equipment approval process, Cingular opposes the adoption of rules governing SDR at this time. As Nortel correctly noted:

> The Commission historically has allowed a technology to crystallize, and private industry to adopt appropriate standards, before the Commission codifies rules to address the new technology. [T]he Commission should follow a similar process for software defined radios.[24]

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[23] The security and authentication requirements described below should apply to the electronic label to prevent tampering.

[24] Nortel Comments at i-ii.

As the record developed in response to the NOI established, SDR technology is still in its infancy and standards have yet to be developed either domestically or internationally. Accordingly, it is premature to adopt detailed rules governing SDR.

A. Spectrum Efficiency

Cingular supports the Commission's tentative conclusion that there is no current need to propose rule changes designed to increase the efficiency of spectrum.[25] The commercial cellular and PCS industry will develop and deploy SDR technologies only when performance and cost issues make it attractive to do so. When there is sufficient penetration of this technology in the market,[26] studies may be undertaken to determine if any changes are needed in existing spectrum policy. Making spectrum policy changes before this technology has gained sufficient penetration in the market could put an unnecessary burden on equipment manufacturers as well as service providers, possibly stifling the benefits of the technology.

SDR technology is an implementation technique; it is not a spectral efficiency improvement technology. SDR by itself cannot do much more than a traditional radio to squeeze additional bits out of a given band of spectrum. Ultimately, the spectral efficiency of a wireless system depends upon the design of its air interface. The same air interface design can be implemented either using a traditional radio or a SDR with very comparable spectral efficiencies. SDR makes it easier and more cost-effective to implement techniques that can improve the spectral efficiency of a wireless system. Examples of such techniques are smart antennas, adaptive modulation techniques, and adaptive channel coding techniques.[27]

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[25] *NPRM* at ¶¶ 14-15.

[26] As noted above, Cingular does not expect SDR to achieve significant market penetration for at least 10 years.

[27] Of course, these techniques can be implemented using traditional radio architectures. In fact, many of these techniques are being implemented today. SDR merely will permit these techniques to be

These spectral efficiency improvement techniques have the potential to allow a given block of spectrum to support a larger number of users, thereby making it easier for different users to share crowded spectrum without causing interference. Thus, SDR technology enables improvement of spectral efficiency by making it easier and more cost-effective to implement spectral efficiency techniques.

B. Interoperability

There is no need to propose rule changes at this time to improve interoperability between radio services.[28] The SDR Forum is working on a number of the issues — including protocols, channel establishment procedures, authentication, and fraud detection — that need to be resolved before roaming between networks that support different standards is possible.

C. Access Algorithms

Cingular agrees with the Commission's view that it is premature to propose requirements on spectrum access algorithms because SDR technology is still under development.[29] The Commission should proceed with caution regarding policy changes that require SDR transmitters to follow specific algorithms for choosing frequencies that enable sharing of spectrum. There are many unknowns regarding the effect of such algorithms on cellular and PCS systems. Different systems will need to have different types of algorithms to identify frequencies for use.[30]

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implemented in a more cost-effective manner.

[28] *NPRM* at ¶¶ 12-13

[29] *NPRM* at ¶ 32.

[30] Cellular systems already have some algorithms for selecting the most appropriate frequency for use based on received signal strength and lists of frequencies downloaded over-the-air to the phone called Intelligent Roaming Data Bases ("IRDBs"). These IRDB lists guide a phone in selecting the most appropriate frequency for use from a commercial perspective. The phone uses this list in conjunction with measured signal strength and interference values to intelligently decide which frequency to use.

Unlike non-commercial wireless systems, such as those used in the military and civil sectors, CMRS systems utilizing AMPS, TDMA and GSM rely heavily on the concept of frequency reuse as a method of interference avoidance.[31] Wireless operators perform careful frequency planning to ensure that co-channel frequencies are sufficiently separated to achieve acceptable levels of interference in the system, while simultaneously maximizing the capacity of the system. If a proposed algorithm for spectrum sharing allows SDR devices in the system to choose frequencies or transmit parameters that degrade the frequency reuse factor, it could seriously degrade a cellular or PCS system's capacity to support users and/or its quality of service. Accordingly, the Commission should not adopt any rules regarding access algorithms until more is known about SDR technology and its impact on CMRS systems.

[31] Frequency reuse means that the same frequencies (co-channel frequencies) are reused at geographically separated distances.

CONCLUSION

For the foregoing reasons, Cingular generally supports the Commission's efforts to facilitate the development and deployment of SDR. Given the nascency of SDR development, the Commission should adopt rule changes that only affect the equipment authorization process and establish a new class of permissive changes. Additional rule changes governing interoperability, spectrum efficiency, and spectrum sharing should not be adopted until (i) SDR has achieved a substantial market penetration and (ii) studies are undertaken to determine whether rule changes are necessary and what impact these rule changes would have on CMRS operators.

Respectfully submitted,

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March 19, 2001